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H. T. & S. Office Report No. 214

TRANSPORTATION TEST WITH LEMONS FROM SOUTHERN CALIFORNIA TO NEW YORK

May - 1949

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TRANSPORTATION TEST WITH LEMONS FROM SOUTHERN CALIFORNIA TO NEW YORK MAY 18 TO 27, 1949

Object

In the H. T. and S. Office Report No. 195, "Transportation Test with Lemons from Southern California to New York, August 1948", the object was stated as being "to compare different methods of refrigerating lemons during shipment in the warmest summer weather and to determine the most economical and desirable icing service for such shipment". The object of the lemon transportation test herein reported was the same, except that the weather desired was not "the warmest summer weather", but that which could be regarded as typical of late spring or early summer. During this period there is a transition in lemon shipping practice, i.e., from ventilation to ice refrigeration, and the shippers are often uncertain as to when the change to ice refrigeration should be made and how complete an icing service should be selected. The present test was made in order to study the refrigeration performance of some of the less complete and less expensive icing services. (See table 1.)

Test Cars and Loads

Ten cars of warehouse cooled lemons were loaded May 18 from the Ontario-Cucumonga, Queen Colony, and San Dimas Fruit Exchanges. All icing of test cars both at San Bernardino and en route were supervised by the test personnel. The icing records are presented in table 2.

The test cars were of the same series, having the same dimensions throughout. They were fan-equipped and had grates for half-stage refrigeration. The rated capacity of full bunkers and of half-stages was, respectively, 11,500 and 6,300 pounds of chunk ice. The cars were steel sheathed, carried 3-1/2 inches of insulation in floors and ceilings and 3 inches in side and end walls. One car was equipped for a restricted circulation of air through the bunkers as described for car E in H. T. & S. Report No. 195, page 4.

All loads were the prevailing size, 464 boxes; two layers high (on end) eight rows wide and twenty-nine stacks long, having a total weight of about 40,000 pounds.

Two test boxes were placed in each car at the center line, quarter-length position in top and bottom layers. The fruit for these boxes was all from one packing house and one pool.

Temperature Records

Temperature records within the cars were obtained by means of electric resistance thermometers at twelve positions in one end of each car; at bunker, in the seventh stack (quarter-length), and at the doorway. Two of the thermometers gave top and bottom air temperatures near doorway and one showed the temperature of the fruit in the doorway at south side. The remaining nine thermometers were in fruit along the center line.

Route and Running Time

The test was routed via the Santa Fe, Belt Railway Company of Chicago, and Erie railroads to Jersey City. The total elapsed time to Jersey City from San Bernardino was 176 hours and 30 minutes. Of this, 99 hours and 47 minutes (56.5 percent) was running time and 76 hours and 43 minutes (43.5 percent) standing.

Weather Conditions

The weather conditions encountered did not prove to be the most desirable for the purpose of the test. It was considered that an average outside temperature of about 65-70°F. would typify the transitional period under study. The average temperature of the first 4-1/2 days of the test was 65°, which was quite satisfactory, but that for the remainder of the time was only 52.4° which was cooler than desired, resulting in an overall average of only 58.6°F.

The cars arrived in Jersey City the morning of May 27 but were not unloaded until the evening of May 30. During this standing period the average outside temperature was 55.5°.

Condition of Test Fruit and Commercial Loads at Destination

The two test boxes from each car were placed together on a special table where they were opened and unwrapped for inspection and comparison. There was no decay in any of these boxes and the general appearance of the lemons was very uniform and good. Careful comparison, however, showed some lack of firmness of the test lemons from car J, which received standard ventilation from origin. The softer fruits were found only in the top layers.

The commercial loads varied considerably from car to car and among the brands, but were generally of good appearance and firmness. Where pliable or soft fruit was found the condition could be attributed to hollow centers rather than to excessive loss of moisture in transit. Decay was reported from two cars only; namely, cars A and B, three to four percent in the former and two percent in the latter. These cars were loaded dry and precooled 8 hours by carrier. Car B was afterwards initially iced, half-stage, and reiced once in transit, a service which produced and maintained an average fruit temperature of 41.8° from day of departure to unloading at destination. This is a temperature about ten degrees lower than recommended for lemons. Car A received no ice but after precooling in the car the vents were closed to Vaughn with standard ventilation beyond. The average fruit temperature in this car was 53.4°. In considering the decay reported for this car it is interesting to note that car J, which received standard ventilation from origin showed an average fruit temperature of 55.1°, but no decay was reported. The above situation indicates that if a lemon shipper wishes to continue ventilation service into early summer, only the strongest fruit should be selected for such shipment.

Comparison of Air and Fruit Temperatures in Test Cars

Records were kept of the top and bottom air temperatures in the test cars at center line near the doorways in positions to simulate "Liquidometers". The relation between the air and fruit temperatures was found to be substantially the same as reported for the lemon transportation test of August 1948. The discussion of the matter in that report should suffice except it may be mentioned that not only should air temperatures be read as soon as possible after the train stops in order to obtain the closest coincidence between air and fruit temperature, but also that at least in fan cars the bottom air temperature is much the more dependable. In the present report the record of air temperatures and the average fruit temperatures as presented together in tables 3 to 12 inclusive justify this conclusion.

Effect of Refrigeration Service on Temperatures in Transit

The icing services selected for this test were purposely intended to provide less refrigeration than those of August 1948 test because of the likelihood of encountering cooler weather. The icing or ventilation services used are listed in table 1. The most complete service used was for car C, which was half-stage, preiced by carrier, replenished, and two reicings in transit. Under the weather conditions of the test this icing service proved more than adequate. The fruit temperature at time of loading was about 55°F. By the second day on route the average fruit temperature was below 45° and at Chicago it had fallen below 40° and remained so until unloaded in New York. The average fruit temperature was 36.8° on arrival at Jersey City.

On account of the weather being cooler than was anticipated most of the icing plans were modified slightly en route. For example: car H, half-stage, was reiced at Argentine instead of at Waynoka; cars F and G, full bunkers, were to be reiced at Argentine but were not reiced at all; cars B and D, half-stage were reiced at Marion instead of at Argentine; car I, billed half-stage, pre-iced by carrier, replenish, do not reice, was not changed but the bunkers were dry at Emporia, Kansas. The average fruit temperature at this point was 42°. The average fruit temperature rose gradually to 50° by the time of arrival at Jersey City and was 54° at unloading three days later. The refrigeration in this car was quite adequate for lemons. This is only one of numerous instances that can be cited to show that the better indication of proper refrigeration is the temperature of the commodity rather than an inspection of the bunkers. By the latter criterion this car might have been reiced at Argentine or at any other icing station thereafter before unloading in New York.

In the present test there were two icing services which were of special interest; full bunker, preiced by carrier, replenished, do not reice, as compared with half-stage, preiced by carrier, replenished, one reicing in transit. Comparative data for these two services were available for non-fan cars but apparently not for fan cars. In non-fan cars this half-stage service produced somewhat lower temperatures than the full-bunker service. How the services named would compare in fan cars was the question. In the August, 1948 test two fan cars representing these services were included, and they arrived at Jersey City with average transit temperatures of 49.7 and 53.4° for the full bunker and half-stage, respectively. However, as the weather was so hot these cars were reiced at Jersey City with 4000 pounds each. Cars D and E of the present test moved under the same services (i.e. half-stage, PI, Repl., one RI in transit, and full bunker, PI, Repl., DNR). The full bunker car again maintained an average fruit temperature 2 to 3 degrees lower than the half-stage car. The above and recent additional evidence indicates that while the half-stage, PI, Repl., one RI in transit service results in slightly better temperatures for lemons, it is not sufficient to justify the higher cost over the full bunker PI, Repl., DNR service.

Car F, which had restricted air circulation through the bunkers, maintained an average fruit temperature of 50.4°, with little deviation during the entire trip. (This car corresponds to car E of the August, 1948 test). The control for car F was car G, which maintained an average fruit temperature of 41.7°. Both car F and car G were full bunker, pre-iced, replenished, and not reiced.

The temperature of the fruit adjacent to the south door was from one to three degrees higher than the average fruit temperature in the car. It is probable that if similar records had been taken at the north door the temperatures obtained would have been in closer agreement to the car average. It seems reasonable, therefore, to recommend that if doorway fruit temperatures are taken during customary passing inspection they be taken at the north door. Commodity temperatures at doorway at time of unloading are easily determined and constitute a very valuable criterion of refrigeration conditions within the car at that time. The practical coincidence of doorway commodity temperature and the average temperature determined in this test at time of unloading is shown in the following table. In the left hand columns are the average top and bottom load temperatures from nine thermometers located along center line of the car and in the right hand columns are Mr. Scanlon's records of the top and bottom temperature obtained manually by means of a fruit thermometer at the time of unloading in New York.

Car	Average fruit temperature		Doorway fruit temperature	
	Top °F.	Bottom °F.	Top °F.	Bottom °F.
A	55	55	57	55
B	41	39	44	42
C	40	38	43	42
D	43	39	43	42
E	45	40	48	47
F	52	47	52	48
G	46	42	49	49
H	40	40	46	44
I	55	53	55	53
J	55	53	55	53

The maximum, minimum and average fruit temperatures for all cars and outside air temperatures are presented in Figures 1 to 8 inclusive.

ACKNOWLEDGMENTS

This test was made possible by the citrus associations, companies, and individuals listed below, whose cooperation and assistance are gratefully acknowledged.

Corona Foothill Lemon Company, Corona, Calif.
Corona Citrus Association, " "
San Dimas Lemon Association, San Dimas, Calif.
Upland Lemon Growers Association, Upland, Calif.
Sierra Madre-Lamanda Citrus Association, Pasadena, Calif.
Mr. R. C. Neill of the Traffic Department, California Fruit Growers Exchange
Mr. C. A. Mulvihill of the Santa Fe Refrigerator Department.

The Santa Fe, the Belt Railroad Company of Chicago, and the Erie railroads, over which the train travelled, and the Santa Fe and Erie for providing business cars for the test party.

Besides the members of the test party the following assisted in preparing or overseeing the loading of the test cars: J. R. MacRill, James Palmer, and Carl Waldapfel of the California Fruit Growers Exchange; R. D. Mantel of the Preco Corporation; G. L. Rygg and H. F. Barber of the United States Department of Agriculture.

Mr. James A. Scanlon, inspector for the California Fruit Growers Exchange, and the staff of the U. S. Department of Agriculture Market Pathology Laboratory in New York, who assisted in unloading the test cars and inspecting the test fruit.

Members of the test party were:

E. M. Harvey, U. S. Department of Agriculture
E. P. Atrops, " " " " "
W. H. Redit, " " " " " ,
San Bernardino to New York .
W. F. Kearns, Santa Fe Refrigerator Department,
San Bernardino to Belen.
F. M. Robinson, Santa Fe Refrigerator Department,
Belen to Chicago.

TABLE No. 1

LOADING DATA

	A RD 14718	B RD 15136	C RD 14308	D RD 14348	E RD 15140
Shipper	San Dimas Lemon Assn. San Dimas	Corona Citrus Assn. Corona	Corona Foothill Lemon Co. Corona	Corona Foothill Lemon Co. Corona	Corona Foothill Lemon Co. Corona
Icing[1/] Service	Dry car. PC by C 8 hrs. Vents cl. to Vaughn. Std. vent. thereafter.	Half Stage. Rule 245 & 255 (Dry car PC by C 8 hrs. II by C. RI at Marion).	Half Stage. Rule 239 & 255 (PI by C. Repl. RI Argentine & Hornell).	Half Stage. Rule 239 & 255 (PI BY C. Repl. RI Marion).	Full Bunker. Rule 239 (PI by C. Repl. DNR).
Fans	Fans on	Fans on	Fans on	Fans on	Fans on
Loading period 5/18	8:00 a.m.- 1:46 p.m.	7:00 a.m.- 8:30 a.m.	7:30 a.m.- 12 M	10 a.m.- 3 p.m.	1:30 p.m.- 5:00 p.m.

[1/] Key:
PI by C - Preiced by carrier.
II by C - Initially iced by carrier.
RI - Reiced in transit.
PC by C - Precooled by carrier.
Repl. - Bunkers replenished at first regular icing station.
DNR - Do not reice in transit.

TABLE NO. 1 (Cont'd)

LOADING DATA

	F RD 15337	G RD 15242	H RD 15287	I RD 14474	J RD 14490
Shipper	Upland Lemon Grs. Assn. Upland	Upland Lemon Grs. Assn. Upland	San Dimas Lemon Assn. San Dimas	Sierra Madre-Lamanda Citrus Assn. Pasadena,	Sierra Madre-Lamanda Cit. Assn. Pasadena
Icing Service	Full Bunker. Rule 239 (PI by C. Repl. Not reiced in transit).	Full Bunker. Rule 239 (PI by C. Repl. Not reiced in transit).	Half Stage. Rule 249 & 255 (Dry car II by C. RI Argentine).	Half Stage. Rule 239 & 255 (PI by C. Repl. DNR).	Standard ventilation
Fans	Fans on. Restricted Bunker circulation.	Fans on.	Fans on.	Fans on.	Fans on.
Loading period 5/18	8:15 a.m.- 12 M	9:20 a.m.- 4 p.m.	8:00 a.m.- 3:30 p.m.	8:00 a.m.- 3:05 p.m.	7:15 a.m.- 2:15 p.m.

TABLE 2

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Lemons

ICING RECORD

			Date May	A Dry Car	B Half Stage Pounds	C Half Stage Pounds	D Half Stage Pounds	E Full Bunker Pounds	F Full Bunker Pounds	G Full Bunker Pounds	H Half Stage Pounds	I Half Stage Pounds	J Dry Car
Preiced	San Bernardino	10 am	17			6600	6600	11,850	11,400	11,400		6900	
Replenished	" "	10 am	19			2400	2550	2325	1,200	1,800		2400	
Initial icing	" "	10 am	19	Ventilated	6900						6750		Ventilated
Reiced	Argentine	8 pm	23			6146					6505		
	Marion	8 pm	25		6400		6400						
	Hornell	2 pm	26			3400							
Total Ice Supplied to Jersey City					13,300	18,546	15,550	14,175	12,600	13,200	13,255	9,300	
Ice Remaining Arrival Jersey City					2,630	4,575	2,360	1,200	2,880	1,440	1,575	0	
Ice Melted to Jersey City					10,670	13,971	13,190	12,975	9,720	11,760	11,680	9,300	
Ice Supplied at Jersey City					0	0	0	0	0	0	0		

NOTE: Chunk ice was used for all icings of all test cars.

TABLE 3 - Car A

TEMPERATURES IN TRANSIT

Precooled by Carrier 8 Hrs. Vents closed to Vaughn. Standard vent beyond.

Station	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BC CL	MD SS	Top Air	Bot Air	AVE TOP	AVE BOT
San Bernardino	18	9:00P	57°F	545	555	540	545	550	550	550	545	540	555	555	535	547	545
					Precooled 8 hours San Bernardino 10:40 p.m.												
" "	19	10 A	57	415	435	380	415	460	450	370	435	435	370	410	370	410	413
" "		5 P	55	435	450	410	435	470	470	390	450	450	400	465	415	432	430
Barstow		10 P	51	450	460	430	450	475	470	405	460	455	425	460	450	447	440
Needles	20	7 A	66	465	475	460	465	485	480	440	475	465	450	480	470	467	460
Seligman, Ariz.		3 P	69	480	495	485	485	500	495	465	490	480	485	545	495	487	478
Winslow		12 Mid.	49	490	510	500	490	505	505	480	495	490	505	520	505	500	488
Gallop, N.M.	21	6 A	32	500	510	505	495	510	510	490	500	495	505	500	500	503	495
Belen		12 M	72	510	520	520	510	520	520	510	515	510	515	545	515	517	512
Vaughn		7 P	64	515	530	530	515	525	525	510	515	510	530	575	530	525	512
					Vents opened at Vaughn - 7:15 P												
Amarillo, Texas	22	9:30A	70	525	555	555	520	540	540	530	525	520	555	635	550	545	525
Waynoka, Okla.		7:30P	72	560	630	640	555	590	605	565	570	565	635	715	590	610	567
Emporia, Kas.	23	7:00A	64	580	640	625	575	600	610	600	590	590	630	610	615	615	593
Argentine		2:00P	85	605	665	670	600	630	640	620	610	610	665	795	645	647	613
"		9:00P	65	620	685	685	615	635	650	630	615	615	690	710	645	663	620
Shopton, Iowa	24	8 A	56	585	610	595	590	580	595	595	580	580	595	545	570	597	585
McCook, Ill.		9 P	51	570	610	580	---	570	580	575	570	570	580	530	565	587	572
Hammond, Ind.	25	8:30A	56	555	580	570	---	570	575	535	560	565	560	515	525	568	553
Huntington		3:30P	60	550	570	570	550	570	565	550	560	565	560	585	565	563	560
Marion, O		7:30P	55	555	570	570	555	570	570	555	565	560	560	555	565	565	560
Salamanca	26	10:30A	49	540	520	510	545	530	525	550	545	535	510	485	520	523	543
Hornell		2 P	54	540	520	515	540	530	525	545	540	535	515	545	525	525	540
Jersey City	27	7 A	48	525	500	490	530	515	510	530	525	520	485	470	510	505	525
" "	28	11 A	60	545	540	525	540	540	540	545	545	535	530	555	530	537	542
New York	29	12 M	62	530	560	550	535	550	550	550	545	545	550	595	565	547	547
" "	30	12 M	64	535	570	555	540	560	560	545	550	555	560	605	560	553	550

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TABLE 4 - Car B

TEMPERATURES IN TRANSIT

Half-stage. Precooled by Carrier 8 Hrs. Initially Iced by Carrier. One RI Marion

Station	Date	Time	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	May		°F.														
Corona, Calif.	18	8:30A	59	600	600	605	600	610	600	615	605	605	605	585	575	602	608
San Bernardino		10:30P	57	570	570	570	570	580	575	575	580	575	575	565	565	570	577
					Precooled 8 hours, San Bernardino 10:40P												
" "	19	10A	57	530	440	400	505	500	485	395	500	465	410	415	390	457	453
					Initially iced San Bernardino 11:00A												
" "		5P	55	515	465	415	495	495	490	395	490	460	430	445	410	465	448
Barstow		10:30P	51	490	440	415	485	480	475	405	480	455	425	395	430	448	447
Needles	20	7A	66	455	420	405	460	460	455	420	460	440	420	395	425	427	440
Saligman, Ariz.		3P	69	440	415	410	455	460	445	425	455	440	420	430	435	422	440
Winslow		12MID	49	425	405	405	435	435	430	425	440	435	425	405	435	412	433
Gallup, N. M.	21	6A	32	415	400	400	430	430	425	425	435	430	415	380	425	405	430
Belen		12M	72	420	410	410	430	425	425	430	430	430	420	425	425	413	430
Vaughn		7P	64	405	400	400	430	420	415	420	425	420	420	430	425	402	422
Amarilla, Texas	22	9:30A	70	400	400	400	410	410	410	415	415	420	420	400	420	400	417
Waynoka, Okla.		7:30P	72	405	405	405	405	415	410	415	415	420	425	460	430	405	417
Emporia, Kas.	23	7A	64	405	405	405	405	415	410	415	410	420	425	405	425	405	415
Argentine		2P	85	405	410	410	405	415	420	420	415	420	435	485	435	408	418
"		9P	65	415	415	415	410	420	420	415	420	425	465	515	455	415	420
Shopton, Ia.	24	8A	56	415	420	420	410	420	420	420	415	425	450	420	430	418	420
McCook, Ill.		9P	51	420	425	430	415	425	430	420	420	430	445	440	440	425	423
Hammond, Ind.	25	8:30A	56	425	430	430	415	430	430	420	425	435	450	420	440	428	427
Huntington		3:30P	60	425	430	430	415	430	435	420	425	435	445	435	435	428	427
Marion, O.		7:30P	55	425	435	435	420	435	435	425	425	435	445	440	440	432	428
					Reiced Marion, 7:30P.												
Salamanca, N.Y.	26	10:30A	49	400	385	395	400	405	405	415	400	410	410	370	400	393	408
Hornell		2P	54	395	385	395	400	405	405	415	400	410	405	385	305	392	408
Jersey City, N.J.	27	7A	48	380	380	385	390	395	390	400	390	400	395	375	400	382	397
" "	28	11A	60	395	395	400	395	400	400	385	395	410	420	415	400	397	397
New York, N.Y.	29	12M	62	400	405	410	395	400	405	375	395	410	430	440	400	405	393
" "	30	12M	64	400	410	415	395	400	405	370	395	410	435	435	400	408	392

TABLE 5 - Car C

Lemons

TEMPERATURES IN TRANSIT

Half-stage. Preiced by Carrier. Replenished. Reiced Argentine and Hornell

Station	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD CL	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10A		Preiced at San Bernardino,													
Corona, Calif.	18	2:30P	63°F	570	575	575	555	560	575	540	565	540	575	575	420	573	548
San Bernardino	19	10 A	57	500	535	515	480	495	510	445	500	465	515	510	410	517	470
				Replenished at San Bernardino, 11 A.													
" "		5 P	55	500	560	500	475	490	505	435	490	460	510	500	410	520	462
Barstow		10:30P	51	465	475	465	465	460	490	430	--	455	490	415	445	468	443
Needles	20	7:00A	66	435	430	430	445	435	470	420	--	445	460	405	430	432	433
Seligman, Ariz.		3 P	69	435	425	425	445	440	460	430	--	445	450	440	445	428	438
Winslow		12 MID.	49	420	415	415	430	430	445	420	---	440	445	415	435	417	430
Gallup, NM.	21	6 A	32	410	400	405	420	415	435	415	--	430	430	385	425	405	423
Belen		12 M	72	415	410	410	425	420	430	420	--	435	430	435	420	412	428
Vaughn		7 P	64	410	405	410	415	415	420	410	--	430	430	440	435	408	420
Amarillo, Texas	22	9:30A	70	405	400	405	410	405	415	410	--	420	425	410	420	403	415
Waynoka, Okla.		7:30P	72	415	410	420	415	415	415	415	--	425	435	475	440	415	420
Emporia, Kas.	23	7:00A	64	415	415	420	415	415	415	415	--	420	430	425	430	417	418
Argentina		2 P	85	425	420	430	420	425	420	425	--	430	440	515	450	425	428
				Reiced Argentine, 7:40 P.													
"		9 P	65	435	435	440	425	430	425	425	--	430	465	515	435	437	428
Shopton, Ia.	24	8 A	56	405	405	395	405	395	410	410	--	410	420	390	410	402	410
McCook, Ill.		9 P	51	395	390	390	400	390	400	400	--	405	410	400	410	392	403
Hammond, Ind.	25	8:30A	56	390	390	390	395	395	400	395	--	405	410	390	400	390	400
Huntington		3:30P	60	390	385	385	390	385	395	390	--	395	405	385	395	387	393
Marion, O.		7:30P	55	380	375	375	385	380	390	390	--	390	395	385	395	377	390
Salamanca, NY.	26	10:30A	49	370	365	365	375	365	380	380	--	380	380	365	385	367	380
Hornell		2 P	54	375	370	370	380	370	380	385	--	380	385	385	390	372	383
				Reiced Hornell, 2 P.													
Jersey City, NJ	27	7 A	48	365	360	360	370	360	370	375	--	375	375	370	380	362	375
" "	28	11 A	60	380	380	385	375	380	380	375	--	390	410	415	385	382	383
New York, NY	29	12 M	62	385	390	390	380	385	385	370	--	390	415	435	390	388	380
" "	30	12 M	64	390	400	395	385	390	385	370	--	390	420	435	385	395	380

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Lemons

TABLE 6 - Car D

TEMPERATURES IN TRANSIT

Half-stage. Preiced by Carrier. Replenished. Reiced once, at Marion

STATION	DATE May	TIME	Out-side	TB GL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10 A			Preiced, San Bernardino.												
Corona, Calif.	18	2 P	63°F	580	585	600	580	570	595	555	580	565	595	615	570	588	567
San Bernardino	19	10 A	57	520	525	555	490	510	525	450	485	475	540	515	435	533	470
					Replenished, San Bernardino. 11 A.												
" "		5 P	55	510	520	560	485	495	525	440	475	465	535	510	425	530	460
Barstow	19	10 P	51	490	480	510	470	475	495	435	475	465	510	425	-	493	458
Needles	20	7 A	66	460	440	480	450	455	465	430	460	455	475	410	445	460	448
Seligman, Ariz.		3 P	69	450	430	465	445	450	455	430	455	455	470	445	455	448	447
Winslow		12 MID	49	435	420	455	435	445	445	420	445	445	460	420	440	437	437
Gallup, NM.	21	6 A	32	425	410	435	420	435	430	415	440	440	440	390	435	423	432
Belen		12 M	72	425	410	440	425	435	430	420	440	440	440	440	395	425	433
Vaughn		7 P	64	420	410	430	415	425	425	410	430	435	440	440	410	420	425
Amarillo, Texas	22	9:30A	70	415	405	420	410	420	420	405	425	430	435	415	430	413	420
Waynoka, Okla.		7:30P	72	415	415	435	415	425	425	410	430	430	445	475	440	422	423
Emporia, Kas.	23	7 A	64	420	415	430	415	425	425	415	425	430	440	430	430	422	423
Argentine		2 P	85	435	425	440	420	430	430	420	430	435	450	510	440	433	428
"		9 P	65	435	435	450	420	430	435	420	435	435	475	545	460	440	430
Shopton, Iowa	24	8 A	56	445	445	460	435	440	450	435	440	440	465	460	450	450	438
McCook, Ill.		9 P	51	460	460	475	445	455	465	450	455	450	470	485	460	465	452
Hammond, Ind.	25	8:30A	56	460	460	480	445	450	460	445	450	455	465	460	450	467	450
Huntington		3:30P	60	460	460	480	450	460	465	450	455	455	470	480	460	467	453
Marion, O.		7:30P	55	470	470	485	460	465	475	460	465	465	475	490	465	475	463
					Reiced, Marion, 7:30 P.												
Salamanca, NY	26	10:30A	49	425	405	415	405	415	415	420	420	430	430	385	415	415	423
Hornell		2 P	54	420	400	435	405	415	410	415	420	430	425	395	415	418	422
Jersey City, NJ	27	7 A	48	400	390	415	390	405	400	395	410	415	410	390	405	402	407
" "	28	11 A	60	415	405	440	395	410	410	385	405	410	435	430	390	420	400
New York, NY	29	12 M	62	420	415	435	395	415	420	380	405	410	445	450	395	423	398
" "	30	12 M	64	425	415	445	395	410	415	375	395	405	445	450	390	428	392

TABLE 7 - Car E

Lemons

TEMPERATURES IN TRANSIT

Full bunker. Preiced by Carrier, Replenished. Do Not Reice.

STATION	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10A				Preiced San Bernardino											
Corona	18	4:30P	63°F	580	590	590	580	580	585	560	575	570	590	600	440	577	568
San Bernardino	19	10 A	57	515	525	520	485	505	515	435	460	465	530	510	420	520	453
						Replenished San Bernardino 11A											
San Bernardino		5 P	55	505	520	515	475	495	500	415	450	455	520	500	410	513	440
Barstow		10:30P	51	470	460	465	460	460	485	420	450	455	480	410	455	465	442
Needles	20	7 A	66	440	420	420	430	425	450	420	435	445	440	395	435	427	433
Seligman, Ariz.		3 P	69	425	410	415	425	420	435	420	430	440	435	420	440	417	430
Winslow		12 MID	49	410	400	400	410	410	420	410	420	430	420	400	430	403	420
Gallup, NM.	21	6 A	32	400	390	390	400	400	410	405	410	425	410	365	420	393	413
Belen, NM		12 M	72	405	395	395	410	405	415	415	420	425	410	420	425	398	420
Vaughn		7 P	64	400	395	400	400	400	405	400	410	420	410	425	420	398	410
Amarillo, Texas	22	9:30A	70	385	385	385	390	385	390	390	400	405	400	385	405	385	398
Waynoka, Okla.		7:30P	72	385	395	395	390	390	390	395	400	405	405	450	415	392	400
Emporia, Kas.	23	7 A	64	380	385	385	385	380	380	390	390	400	395	390	400	383	393
Argentine		2 P	85	390	400	400	390	390	390	400	400	405	410	470	415	397	402
"		9 P	65	400	405	405	390	390	390	395	400	405	435	515	430	403	400
Shopton, Iowa	24	8 A	56	390	395	400	390	385	385	395	395	405	405	395	405	395	398
McCook, Ill.		9 P	51	385	395	395	385	385	385	395	395	400	400	405	400	392	397
Hammond, Ind.	25	8:30A	56	390	395	395	385	390	385	385	395	400	405	395	400	393	393
Huntington		3:30P	60	385	390	390	385	385	385	385	395	400	400	395	395	388	393
Marion, O.		7:30P	55	380	390	385	380	380	380	385	390	395	390	395	395	385	390
Salamanca, NY	26	10:30A	49	380	385	380	380	375	375	385	380	390	385	375	390	382	385
Hornell		2 P	54	380	385	385	380	380	380	390	385	390	390	395	390	383	388
Jersey City, NJ	27	7 A	48	380	385	385	380	380	375	385	385	390	390	385	390	383	387
" "	28	11 A	60	405	420	415	395	390	380	390	395	400	425	450	410	413	395
New York, NY	29	12 M	62	425	440	435	405	400	400	395	400	405	440	480	420	433	400
" "	30	12 M	64	440	450	445	415	400	410	395	405	415	445	480	420	445	405

TABLE 8 - Car F

Lemons

TEMPERATURES IN TRANSIT

Full bunker. Preiced by Carrier, Replenished. Restricted Bunker Circulation

STATION	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10 A			Preiced San Bernardino												
San Bernardino	18	9 P	57°F	545	540	545	550	555	565	495	545	540	535	530	510	543	527
" "	19	10 A	57	560	560	585	560	560	580	480	540	520	540	555	465	568	513
					Replenished San Bernardino, 11A												
" "		5 P	55	560	560	570	565	555	580	460	535	515	540	550	465	563	503
Barstow		10:30P	51	540	535	540	555	550	565	480	530	520	535	510	515	538	510
Needles	20	7 A	66	520	510	520	540	535	545	485	525	520	525	505	505	517	510
Seligman, Ariz.		3 P	69	520	510	520	530	535	540	495	530	525	520	545	520	517	517
Winslow		12 MID	49	510	505	515	520	530	530	490	525	520	530	515	515	510	512
Gallup, NM	21	6 A	32	500	495	505	510	525	525	490	520	515	515	490	505	500	508
Belen		12 M	72	505	500	510	515	525	525	490	525	520	520	530	500	505	512
Vaughn		7 P	64	500	500	505	510	520	520	485	520	510	510	540	510	502	505
Amarillo, Texas	22	9 A	70	500	495	500	500	515	515	485	510	505	505	505	500	498	500
Waynoka, Okla.		7:30P	72	505	500	515	500	520	515	485	515	510	515	550	510	507	503
Emporia, Kas	23	7 A	64	500	495	505	485	515	515	485	510	505	515	505	500	500	500
Argentine		2 P	85	505	500	515	505	520	520	490	515	510	515	560	505	507	505
"		9 P	65	515	510	520	505	525	525	485	520	510	535	575	500	515	505
Shopton, Ia.	24	8 A	56	505	500	510	505	515	515	485	510	505	525	505	500	505	500
McCook, Ill.		9 P	51	500	500	510	500	515	515	485	515	505	520	515	495	503	502
Hammond, Ind.	25	8:30A	56	500	500	505	500	515	520	470	510	500	510	490	475	502	493
Huntington		3:30P	60	495	490	495	495	505	510	475	510	495	500	495	490	493	493
Marion, O.		7:30P	55	490	485	495	495	505	505	475	505	495	500	495	485	490	492
Salamanca, NY.	26	10:30A	49	480	475	485	480	495	495	470	500	490	490	475	475	480	487
Hornell		2 P	54	485	475	485	485	500	500	470	500	490	490	490	480	482	487
Jersey City, NJ.	27	8 A	48	475	470	480	475	495	495	465	495	485	490	475	465	475	482
" "	28	11 A	60	495	495	495	490	505	510	460	495	475	495	495	440	495	477
New York, NY.	29	12 M.	62	510	505	510	500	505	520	445	485	465	500	510	435	508	465
" "	30	12 M	64	520	520	520	505	505	530	440	485	465	505	515	435	520	463

TABLE 9 - Car G

TEMPERATURES IN TRANSIT

Full bunker. Preiced by Carrier, Replenished. Do Not Reice.

Station	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10 A		Preiced San Bernardino													
San Bernardino	18	9 P	57°F	530	510	520	550	505	525	485	510	530	520	490	465	520	508
" "	19	10 A	57	535	535	530	530	495	515	440	470	490	510	515	420	533	467
				Replenished San Bernardino 11A													
San Bernardino		5 P	55	525	530	525	520	485	510	425	460	480	505	515	420	527	455
Barstow		10:30P	51	490	465	480	505	455	480	425	460	470	475	420	445	478	452
Needles	20	7 A	66	450	425	435	485	425	450	425	450	455	445	405	435	437	443
Seligman, Ariz.		3 P	69	435	420	430	470	420	440	430	445	500	445	435	445	428	442
Winslow		12 MID	49	420	410	415	455	410	425	420	435	440	445	410	435	415	432
Gallup, NM	21	6 A	32	410	400	405	440	400	415	415	430	435	430	380	425	405	427
Belen		12 M	72	410	405	405	440	405	415	420	425	435	425	430	425	407	427
Vaughn		7 P	64	410	400	405	425	400	410	410	420	425	430	430	430	405	418
Amarillo, Texas	22	9:30A	70	400	395	395	415	395	400	405	410	415	415	395	415	397	410
Waynoka, Okla.		7:30P	72	400	400	400	405	390	395	405	410	415	430	455	420	400	410
Emporia, Kas	23	7 A	64	390	395	395	400	385	390	400	405	405	420	395	410	393	403
Argentine		2 P	85	400	405	400	405	395	395	405	410	410	430	480	420	402	408
"		9 P	65	410	415	410	405	395	400	405	410	410	465	520	435	412	408
Shopton, Ia.	24	8 A	56	400	400	400	400	390	395	400	405	410	430	400	410	400	405
McCook, Ill.		9 P	51	400	400	400	400	390	395	400	405	405	425	415	410	400	403
Hammond, Ind.	25	8:30A	56	400	410	405	405	395	395	400	405	410	425	405	410	405	405
Huntington		3:30P	60	395	405	400	400	390	395	395	405	405	415	400	405	400	402
Marion, O.		7:30P	55	395	405	395	395	385	390	395	400	400	410	400	405	398	398
Salamanca, NY.	26	10:30A	49	385	405	385	390	380	385	395	395	395	400	380	430	392	395
Hornell, NY.		2 P	54	390	410	390	390	385	385	395	395	395	400	400	435	397	395
Jersey City, NJ.	27	7 A	48	390	405	390	390	385	390	395	395	395	400	390	435	395	395
" "	28	11 A	60	420	440	415	405	395	405	400	405	405	440	460	445	425	403
New York, NY.	29	12 M	62	440	455	440	415	405	415	405	415	415	455	490	470	445	412
" "	30	12 M	64	455	470	450	425	410	425	410	425	425	465	490	475	458	420

TABLE 10 - Car H

Lemons

TEMPERATURES IN TRANSIT

Half-stage. Initially iced by Carrier. Reiced once, Argentine

STATION	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
San Dimas, Calif.	18	5 P	57°F.	545	545	535	540	550	540	540	550	535	560	575	545	542	542
San Bernardino	19	10 A	57	565	570	565	565	570	570	560	570	560	580	560	560	567	563
						Initially iced San Bernardino 11A											
" "		5 P	55	555	565	555	550	560	570	520	555	545	580	550	495	558	540
Barstow		10:30P	51	536	515	510	535	520	540	505	530	530	550	470	505	520	522
Needles	20	7 A	66	510	470	470	510	490	410	495	500	505	520	455	490	483	500
Seligman, Ariz.		3 P	69	490	460	460	495	475	495	485	485	495	510	475	490	470	488
Winslow		12 MID	49	475	445	445	480	460	480	475	475	490	505	450	480	455	480
Gallup, NM.	21	6 A	32	465	430	430	470	450	465	465	460	470	490	420	465	442	465
Belen		12 M	72	460	435	435	460	445	460	460	465	470	480	460	460	443	465
Vaughn		7 P	64	450	430	430	455	445	450	450	455	460	485	470	465	437	455
Amarillo, Texas	22	9:30A	70	440	430	430	445	435	445	440	445	455	480	440	455	433	447
Waynoka, Okla.		7:30P	72	440	440	440	440	440	445	445	450	450	485	500	465	440	448
Emporia, Kas.	23	7 A	64	440	440	440	440	440	445	445	450	455	485	460	490	440	450
Argentine		2 P	85	450	450	450	445	450	450	450	455	460	500	535	470	450	455
						Reiced 7:15 P. Argentine											
"		9 P	65	450	460	460	445	450	450	450	455	460	525	535	470	457	455
Shopton, Iowa	24	8 A	56	430	415	415	430	415	430	435	430	440	480	410	435	420	435
McCook, Ill.		9 P	51	415	400	405	420	405	415	420	415	425	465	420	430	407	420
Hammond, Ind.	25	8:30A	56	415	405	405	415	410	420	410	420	425	465	410	415	408	418
Huntington		3:30P	60	410	395	395	410	400	410	405	410	420	445	400	415	400	412
Marion, O.		7:30P	55	400	385	385	400	390	400	400	400	410	435	400	405	390	403
Salamanca, NY	26	10:30A	49	390	375	375	390	380	390	395	390	400	420	380	395	380	395
Hornell		2 P	54	390	380	380	390	380	390	400	390	400	420	400	400	383	397
Jersey City, NJ	27	7 A	48	385	375	375	385	375	385	390	385	390	420	390	395	378	388
" "	28	11 A	60	390	395	395	390	395	395	380	395	400	450	435	395	393	392
New York, NY	29	12 M	62	395	400	400	390	395	400	375	395	400	460	455	400	398	390
" "	30	12 M	64	400	410	405	395	400	405	395	400	405	505	460	405	405	400

TABLE 11- Car I

Lemons

TEMPERATURES IN TRANSIT

Half-stage. Preiced by Carrier, Replenished. Do Not Reice

Station	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	BOT AIR	AVE TOP	AVE BOT
	17	10 A			Preiced San Bernardino												
Lamanda Park, Calif.	18	1 P	57°F.	540	540	535	535	525	535	505	520	525	550	545	415	538	517
San Bernardino	19	10 A	57	515	520	525	505	475	520	440	470	475	535	525	425	520	462
					Replenished at San Bernardino 11A												
San Bernardino		5 P	55	510	515	520	500	465	520	425	460	465	530	520	425	515	450
Barstow		10:30P	51	465	470	470	475	470	465	430	465	460	490	435	450	468	452
Needles	20	7 A	66	435	435	435	450	430	430	435	460	450	456	430	445	435	448
Seligman, Ariz.		3 P	69	425	425	430	440	430	425	435	460	445	455	465	450	427	447
Winslow		12 MID	49	415	415	420	435	420	415	435	450	440	445	430	440	417	442
Gallup, NM.	21	6 A	32	405	405	405	420	410	400	430	440	430	430	400	430	405	433
Belen		12 M	72	415	410	410	425	415	410	430	445	435	435	445	435	412	437
Vaughn		7 P	64	410	410	410	415	410	405	420	435	425	435	455	435	410	427
Amarillo, Texas	22	9:30A	70	405	405	405	415	405	400	420	430	420	425	420	425	405	423
Waynoka, Okla		7:30P	72	415	415	415	415	410	415	415	430	435	445	485	440	415	423
Emporia, Kas	23	7 A	64	420	420	420	420	415	420	425	435	425	445	445	435	420	428
Argentine		2 P	85	430	430	435	430	420	430	430	435	430	460	520	445	432	432
"		9 P	65	450	440	440	430	420	445	435	440	435	490	555	460	443	437
Shopton, Iowa	24	8 A	56	450	450	445	440	435	450	440	445	445	475	470	455	448	443
McCook, Ill.		9 P	51	470	465	460	460	450	465	455	460	460	490	495	465	465	458
Hammond, Ind.	25	8:30A	56	465	465	465	460	450	465	460	465	460	485	470	465	465	462
Huntington		3:30P	60	470	470	465	465	460	470	465	470	465	485	490	470	468	466
Marion, O.		7:30P	55	475	475	470	470	465	475	470	470	470	490	500	475	473	470
Salamanca, NY	26	10:30A	49	480	480	475	470	470	475	475	480	475	495	495	480	478	477
Hornell		2 P	54	495	490	485	480	480	485	485	485	485	505	510	490	490	485
Jersey City, NJ	27	7 A	48	500	500	495	490	490	495	500	500	495	510	500	495	498	498
" "	28	11 A	60	525	520	515	510	500	520	510	515	510	540	540	510	520	512
New York, NY	29	12 M	62	540	535	540	525	510	535	525	530	520	555	565	520	538	525
" "	30	12 M	64	550	550	555	535	525	545	535	540	535	565	560	530	552	537

Test 1949-1

LEMONS

TABLE 12 - Car J

TEMPERATURES IN TRANSIT

Standard Ventilation from Point of Origin

STATION	DATE May	TIME	Out-side	TB CL	TQ CL	TD CL	MB R3	MQ R3	MQ R6	BB CL	BQ CL	BD CL	MD SS	TOP AIR	AIR	AVE TOP	AVE BOT
Lamanda Park	18	1 P	57°F	565	560	545	545	545	560	530	540	550	550	555	540	557	540
San Bernardino	19	10 A	57	570	580	570	575	575	580	550	565	570	575	550	555	573	562
" "		5 P	55	570	585	570	575	575	590	555	565	--	580	560	560	575	560
Barstow		10:30P	51	560	535	530	560	550	565	540	540	--	530	500	500	542	540
Needles	20	7 A	66	550	535	520	545	535	545	530	525	540	520	605	540	535	532
Seligman, Ariz.		3 P	69	560	595	570	555	560	565	535	540	550	575	655	570	575	542
Winslow		12 MID	49	545	530	520	535	525	540	520	515	--	525	510	520	532	517
Gallup, NM	21	6 A	32	525	460	465	505	490	510	490	490	--	465	380	465	483	490
Belen		12 M	72	535	535	515	520	520	520	500	500	515	520	660	525	528	505
Vaughn		7 P	64	545	575	545	520	535	530	495	505	--	565	630	540	555	500
Amarillo, Texas	22	9 A	70	540	580	560	540	545	550	530	525	--	570	640	565	560	528
Waynoka, Okla.		7:30P	72	595	670	635	585	610	605	570	570	--	655	725	615	633	570
Emporia, Kas	23	7 A	64	605	625	640	595	605	615	590	590	--	620	615	605	623	590
Argentine		2 P	85	645	690	660	630	645	645	615	615	--	680	805	660	665	615
"		9 P	65	675	700	680	650	640	655	620	620	--	695	715	655	685	620
Shopton, Iowa	24	8 A	56	615	575	580	595	575	610	575	575	580	570	550	565	590	577
McCook, Ill.		9 P	51	580	575	565	570	565	590	555	590	510	565	540	555	573	552
Hammond, Ind.	25	8:30A	56	555	570	555	540	555	575	545	540	545	540	525	515	560	543
Huntington		3:30P	60	555	570	550	545	560	570	525	525	540	550	580	555	558	530
Marion, Ohio		7:30P	55	555	565	550	550	560	565	535	550	550	550	560	555	557	545
Salamanca, NY	26	10:30A	49	540	500	495	530	505	535	510	--	--	490	475	500	512	510
Hornell		2 P	54	535	520	500	525	515	535	510	510	520	505	545	515	518	513
Jersey City, NJ	27	7 A	48	520	495	480	515	500	510	495	495	505	475	465	495	498	498
" "	28	11 A	60	530	535	515	520	520	525	505	510	520	525	570	535	527	512
New York, NY	29	12 M	62	535	555	530	525	530	530	520	520	530	540	610	570	540	523
" "	30	12 M	64	535	560	545	530	540	540	520	525	540	545	620	565	547	528

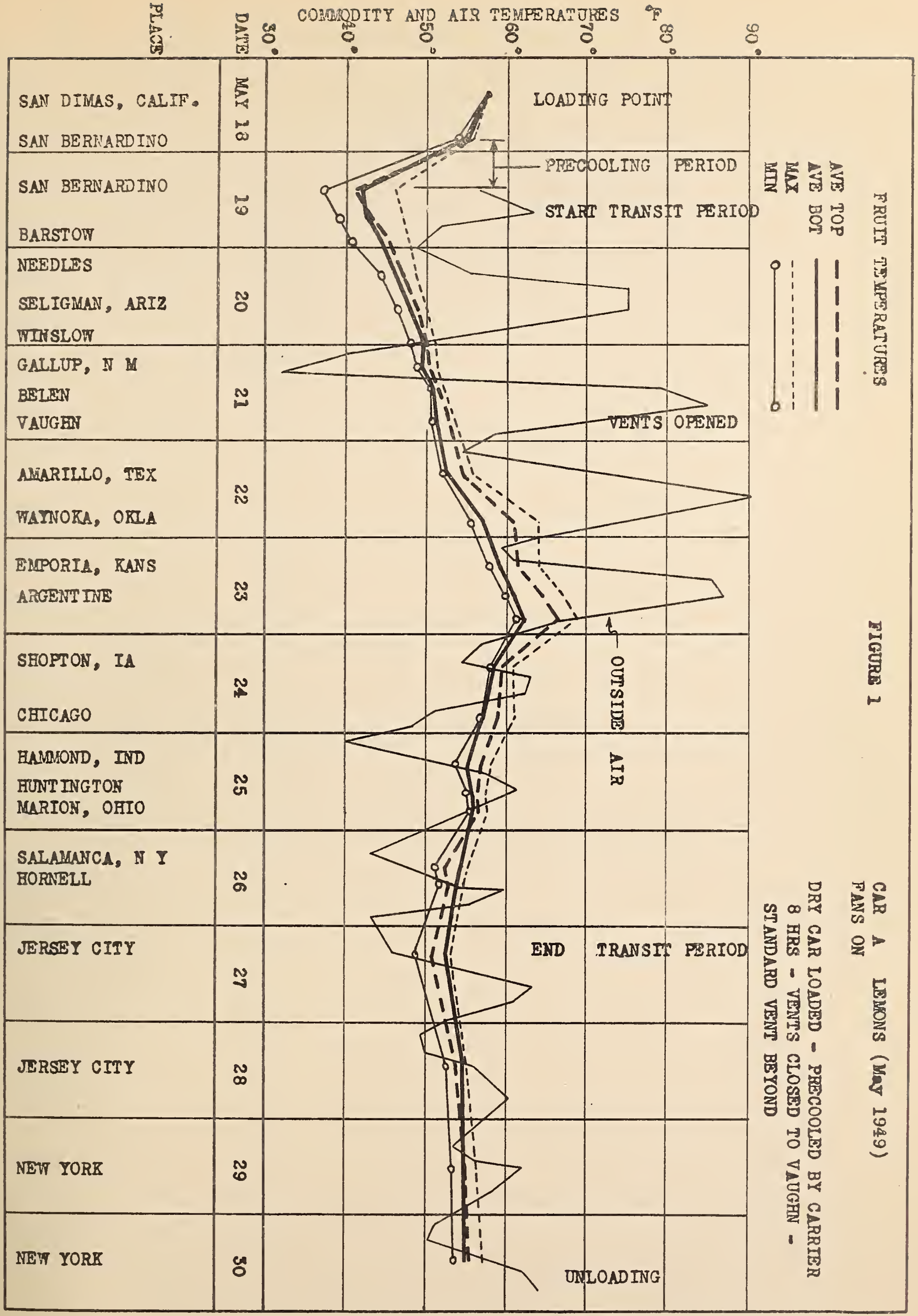


FIGURE 1

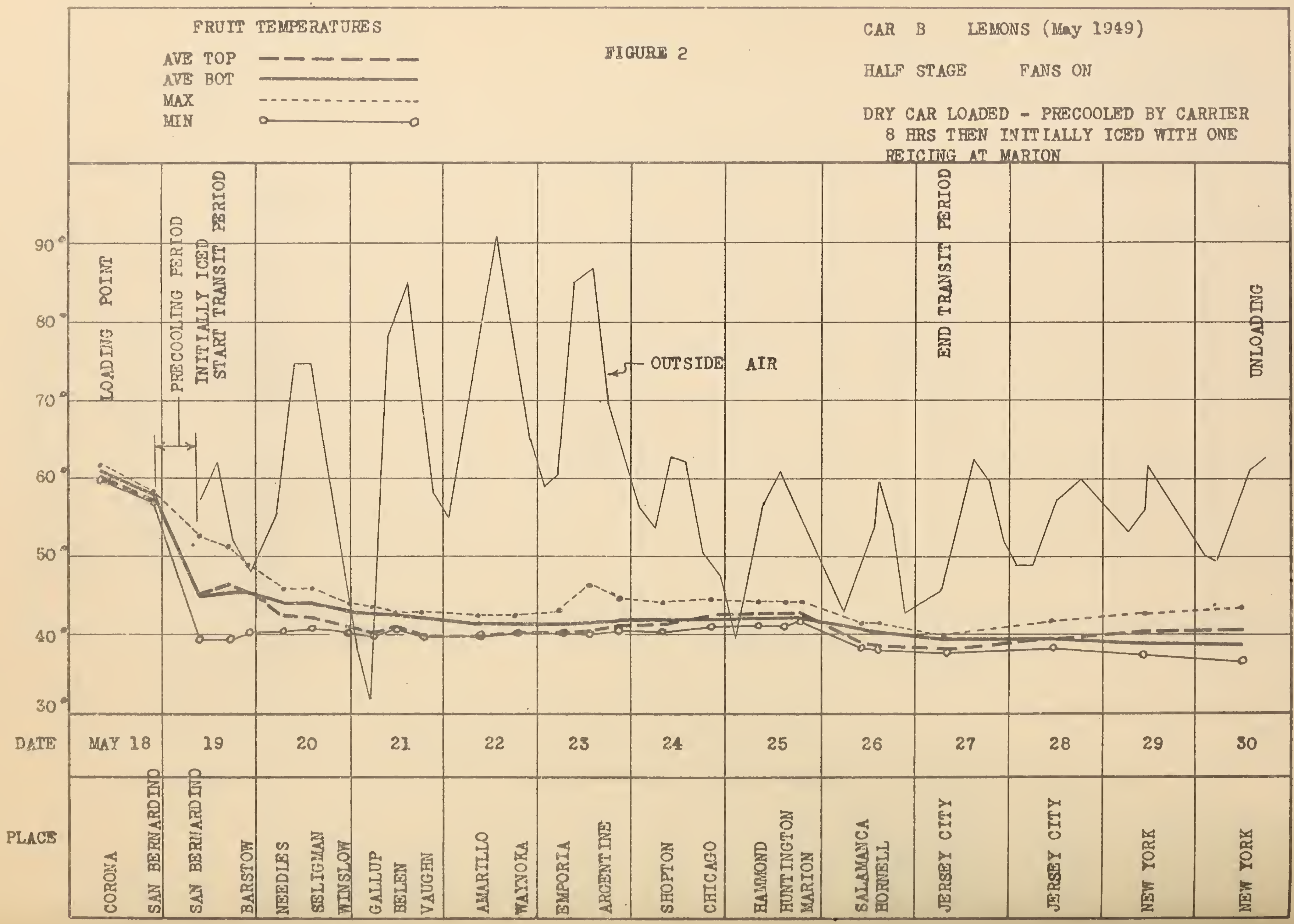
CAR A LEMONS (May 1949)
FANS ON
DRY CAR LOADED - PRECOOLED BY CARRIER
8 HRS - VENTS CLOSED TO VAUGHN -
STANDARD VENT BEYOND

FIGURE 2

CAR B LEMONS (May 1949)

HALF STAGE FANS ON

DRY CAR LOADED - PRECOOLED BY CARRIER 8 HRS THEN INITIALLY ICED WITH ONE REICING AT MARION



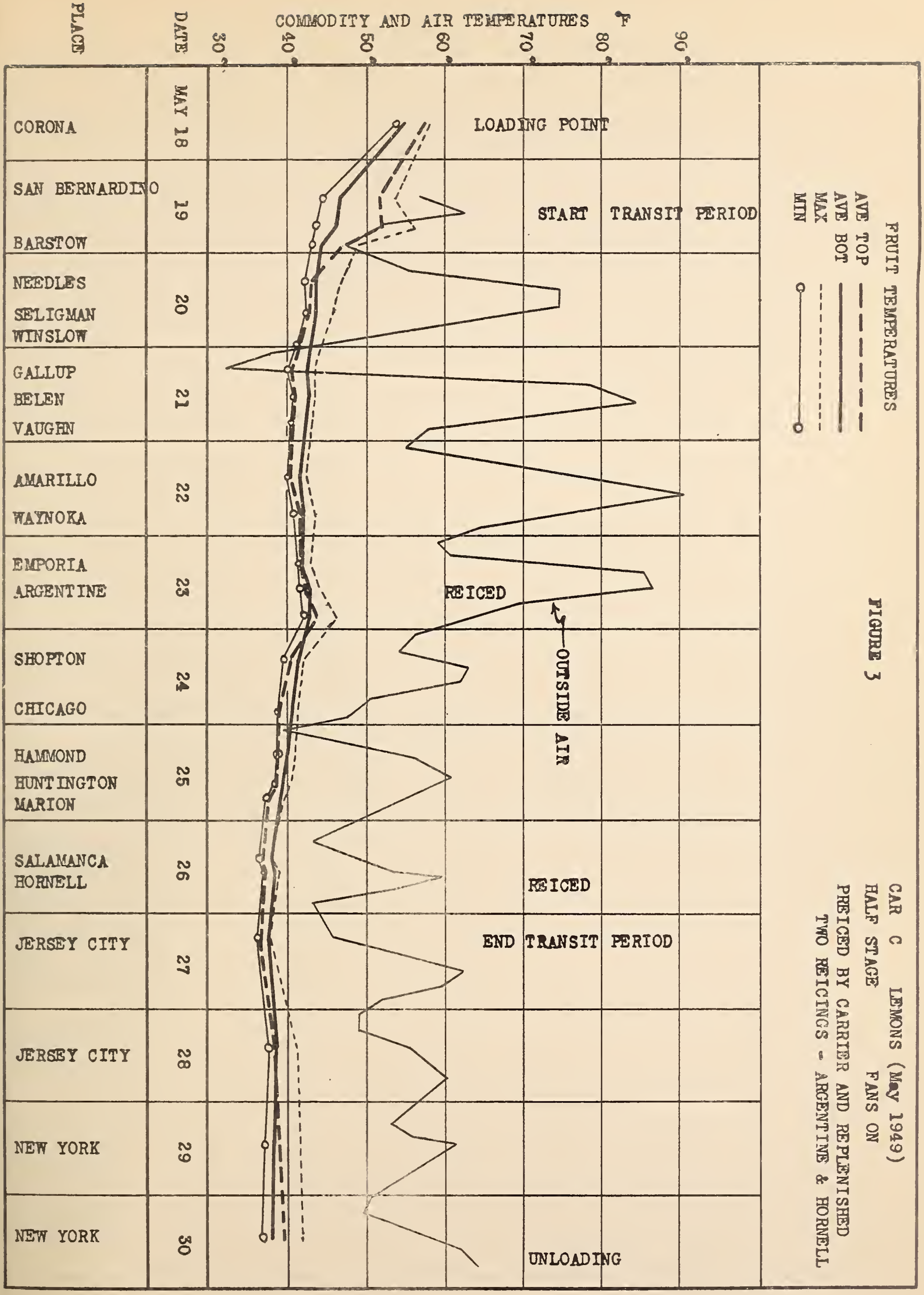


FIGURE 3

CAR C LEMONS (May 1949)
HALF STAGE FANS ON
PREICED BY CARRIER AND REPLENISHED
TWO REICINGS - ARGENTINE & HORNELL

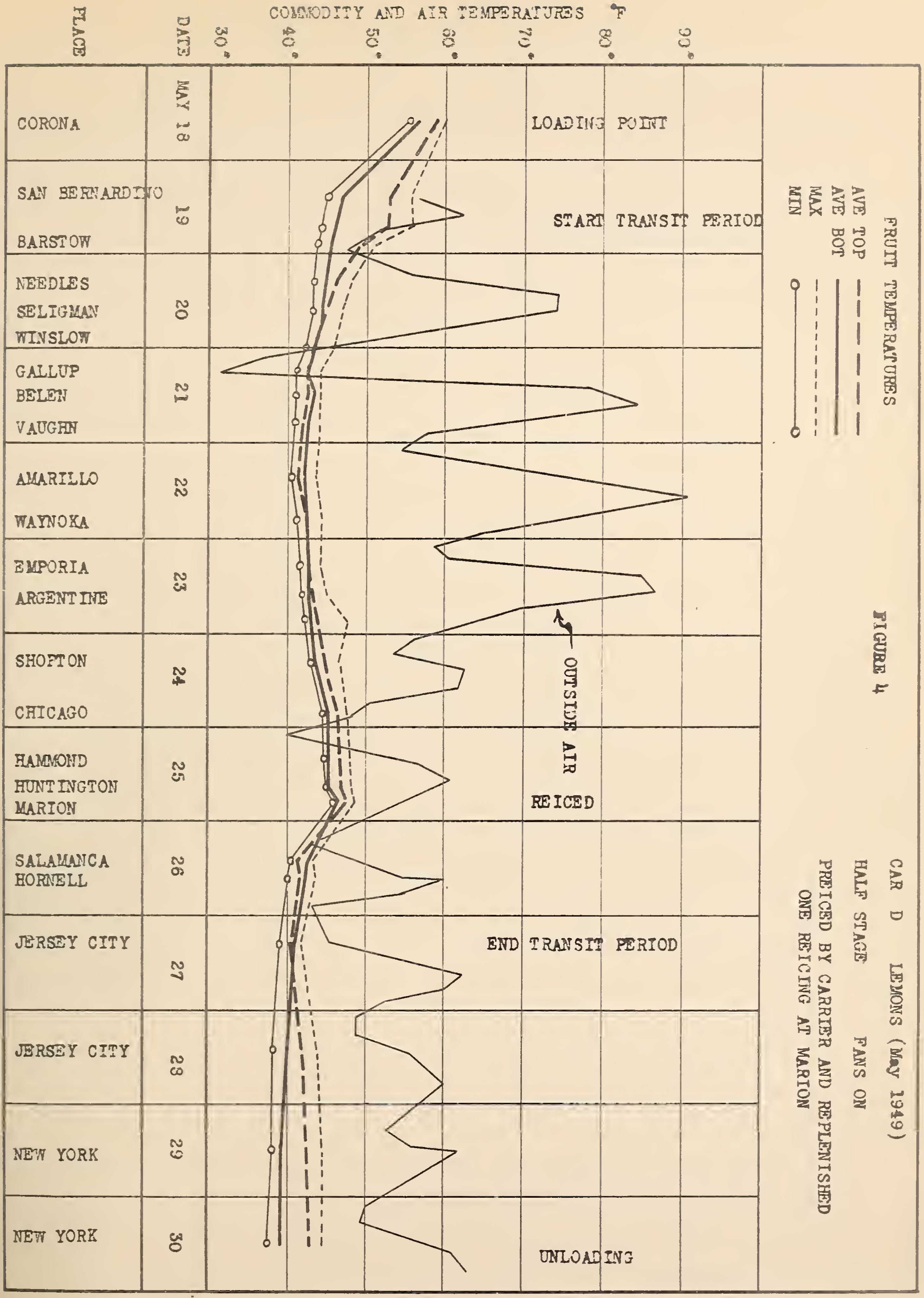


FIGURE 4

CAR D LEMONS (May 1949)

HALF STAGE FANS ON

PREICED BY CARRIER AND REPLENISHED
ONE REICING AT MARION

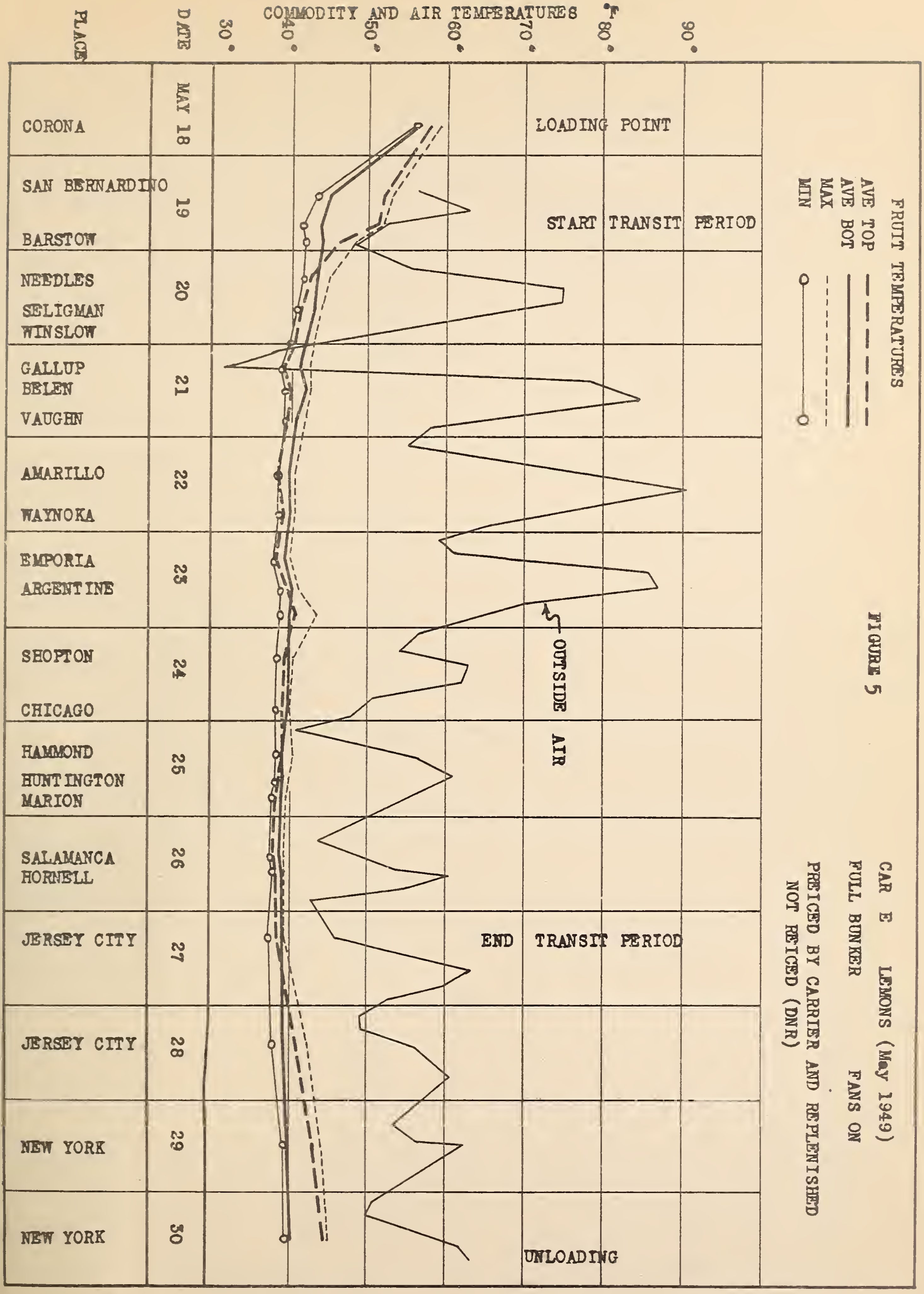


FIGURE 5

CAR E LEMONS (May 1949)
FULL BUNKER FANS ON
PREICED BY CARRIER AND REPLENISHED
NOT REICED (DNR)

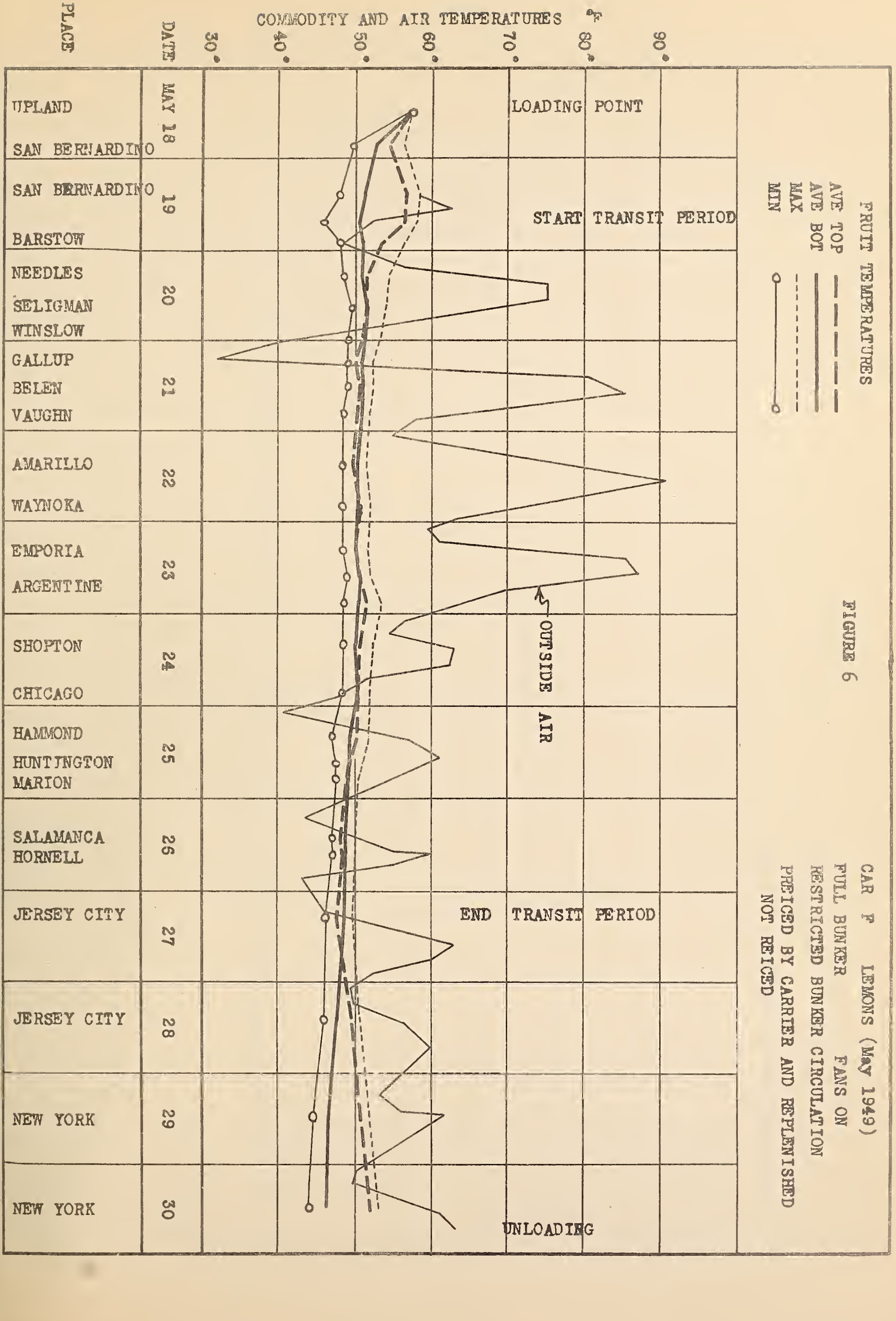


FIGURE 6

CAR F LEMONS (May 1949)
FULL BUNKER FANS ON
RESTRICTED BUNKER CIRCULATION
PREICED BY CARRIER AND REPLENISHED
NOT REICED

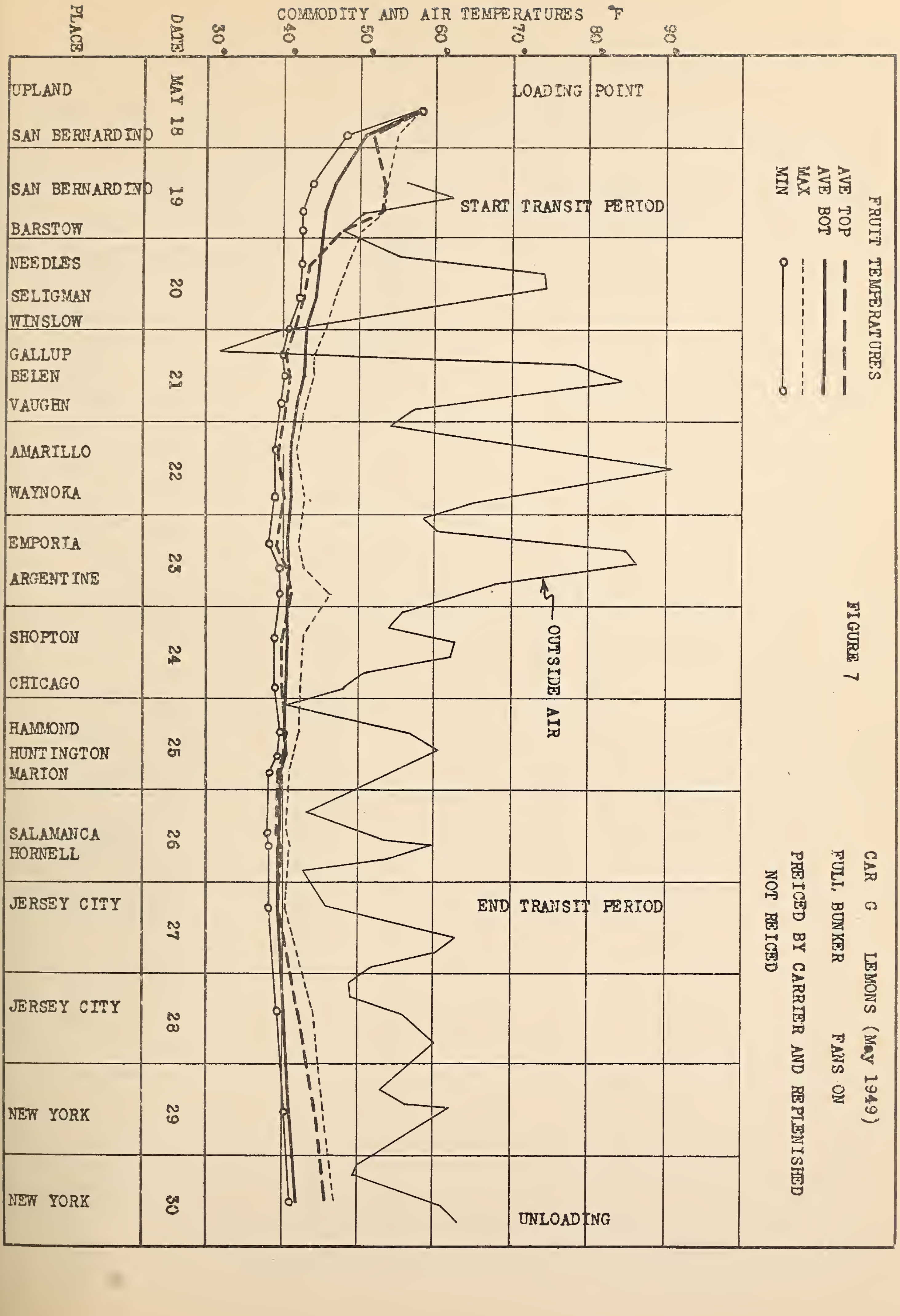


FIGURE 7

CAR G LEMONS (May 1949)
FULL BUNKER FANS ON
PREICED BY CARRIER AND REPLENISHED
NOT REICED

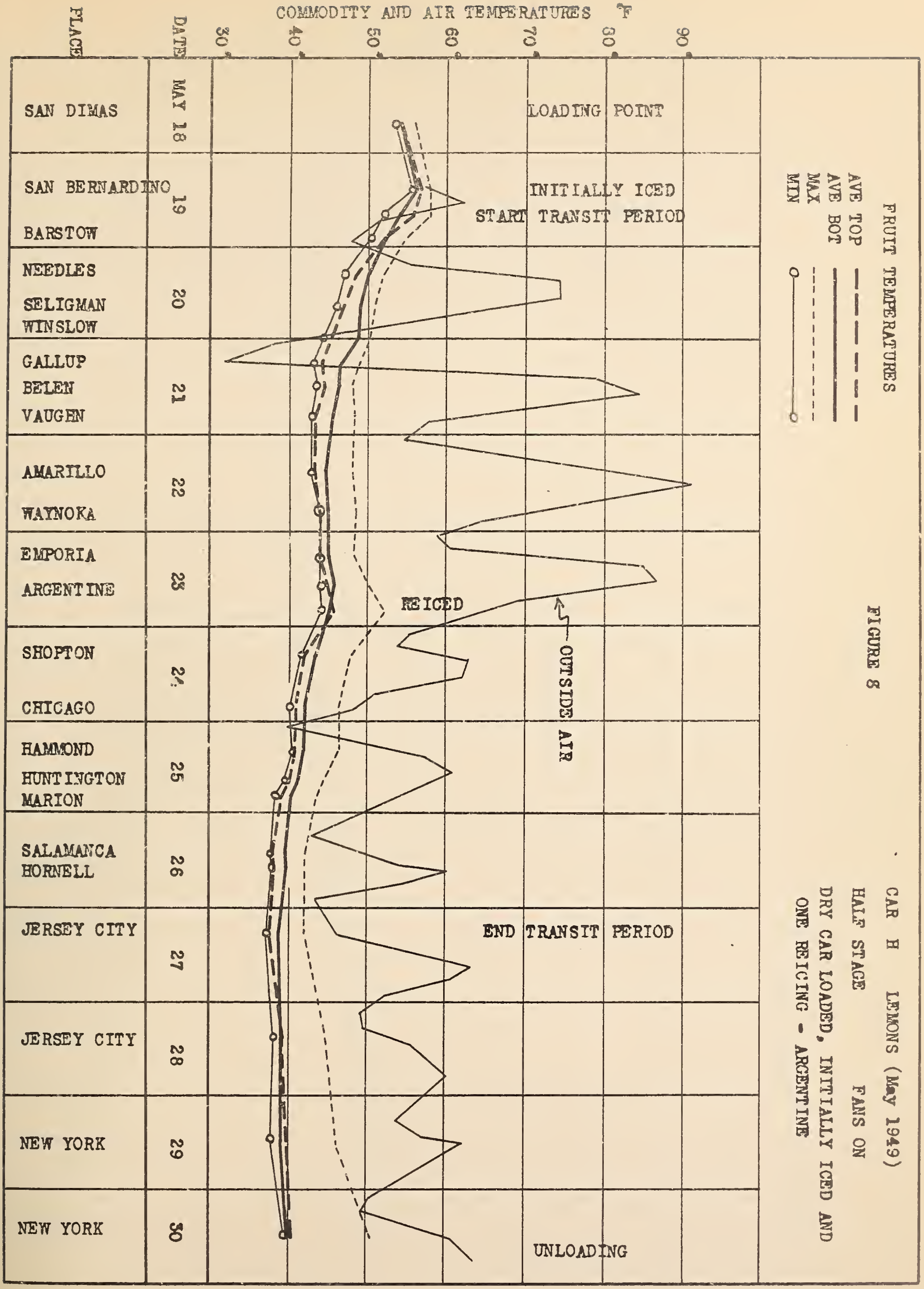


FIGURE 8

CAR H LEMONS (May 1949)
HALF STAGE FANS ON
DRY CAR LOADED, INITIALLY ICED AND
ONE REICING - ARGENTINE

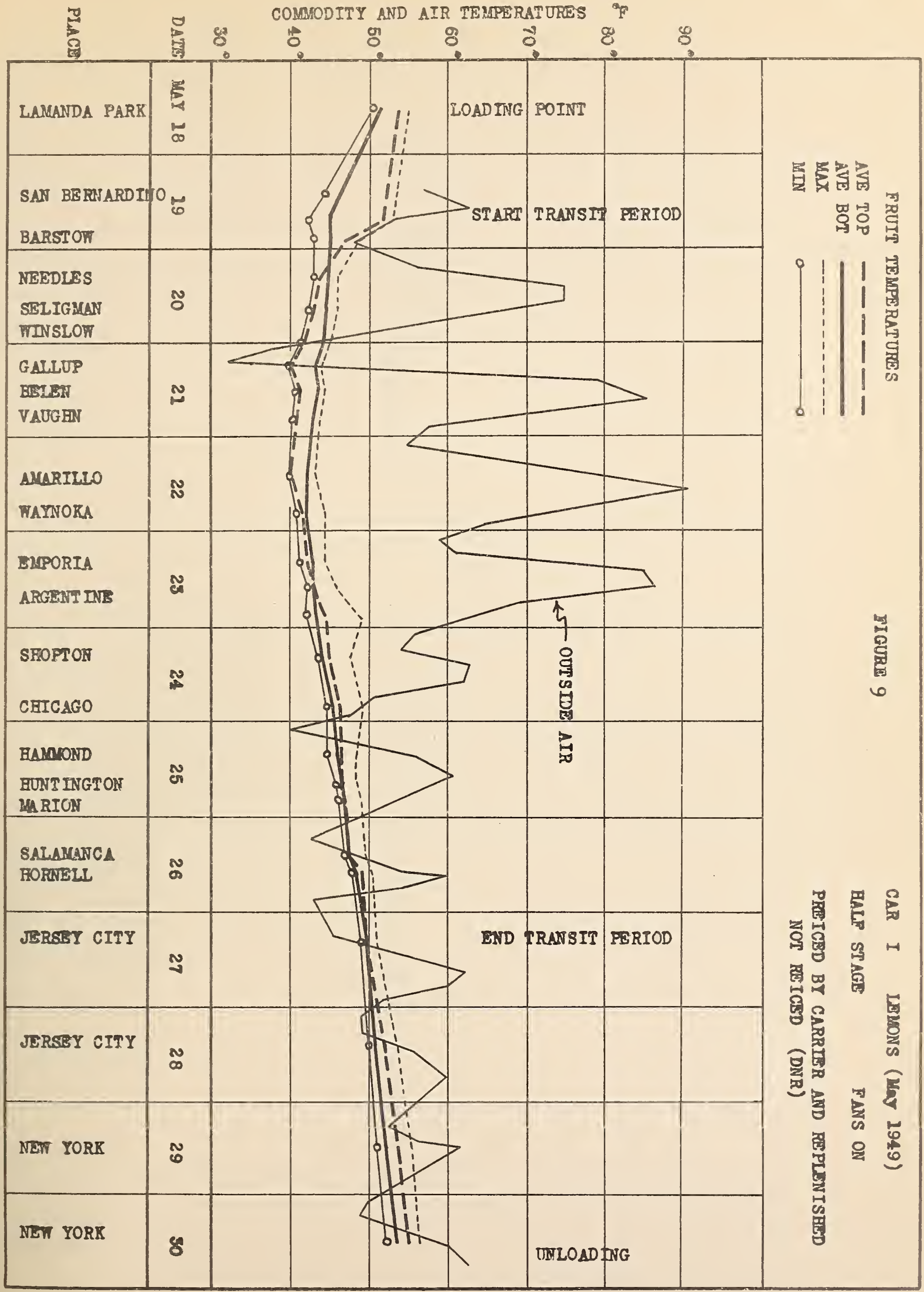
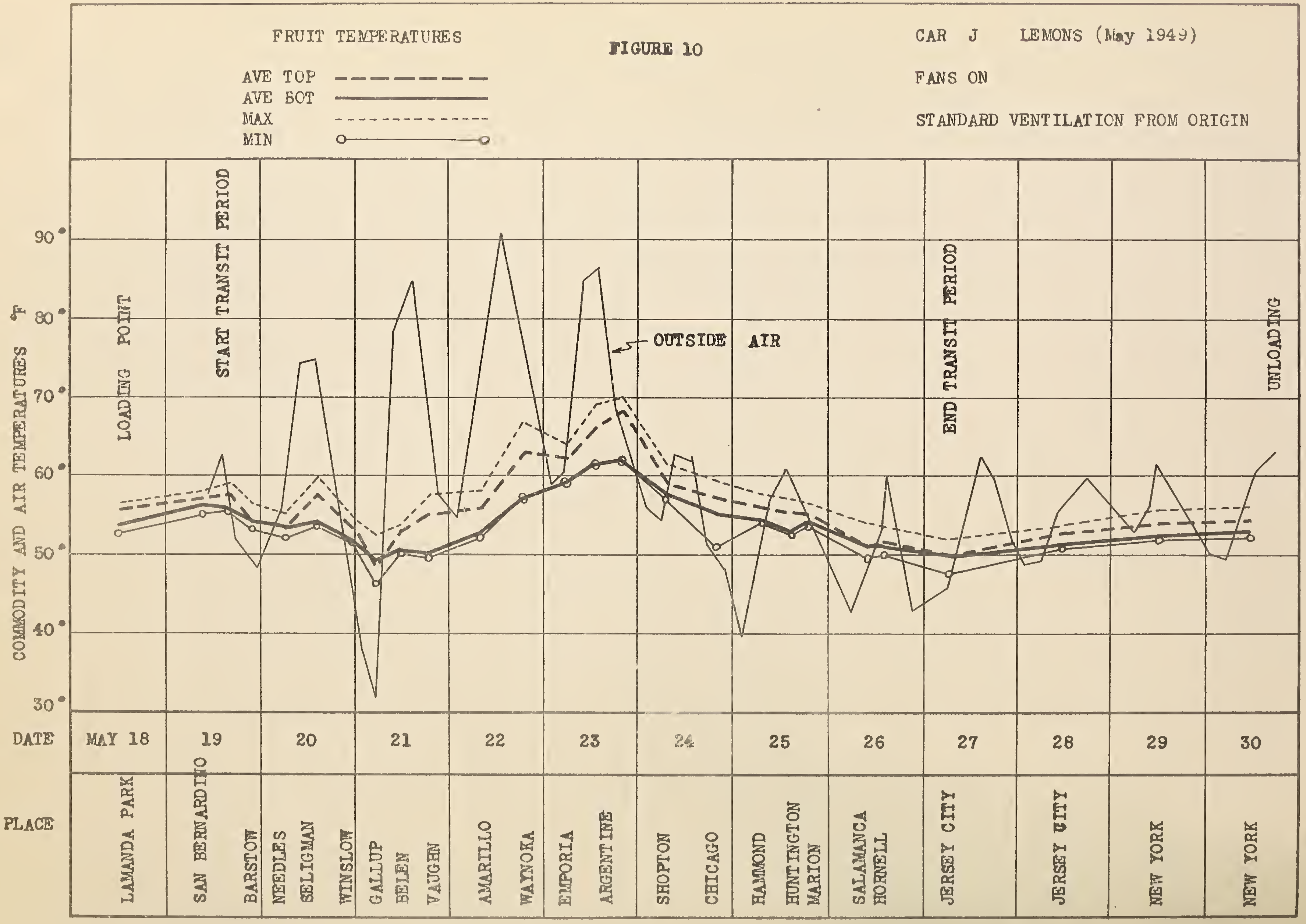


FIGURE 9

CAR I LEMONS (May 1949)
HALF STAGE FANS ON
PREICED BY CARRIER AND REPLENISHED
NOT REICED (DNR)

FIGURE 10


FRUIT TEMPERATURES
AVE TOP
AVE BOT
MAX
MIN
CAR J LEMONS (May 1949)
FANS ON
STANDARD VENTILATION FROM ORIGIN
COMMODITY AND AIR TEMPERATURES °F
30°
40°
50°
60°
70°
80°
90°
LOADING POINT
START TRANSIT PERIOD
OUTSIDE AIR
END TRANSIT PERIOD
UNLOADING
DATE
MAY 18
19
20
21
22
23
24
25
26
27
28
29
30
PLACE
LAMANDA PARK
SAN BERNARDINO
BARSTOW
NEEDLES
SELIGMAN
WINSLOW
GALLUP
BELEN
VAUGHN
AMARILLO
WAYNOKA
EMPORIA
ARGENTINE
SHOPTON
CHICAGO
HAMMOND
HUNTINGTON
MARION
SALAMANCA
HORNELL
JERSEY CITY
JERSEY CITY
NEW YORK
NEW YORK